

NOTES, ABSTRACTS, AND REVIEWS

SOLAR AND TERRESTRIAL RELATIONSHIPS

The first Report of the Commission appointed by the International Research Council to further the study of solar and terrestrial relationships has been received. English and French texts are each printed in full. The body of the report consists of memoranda which form an invaluable summary of the present state of knowledge of the subject and of the outlook for further research. We reprint here a part of the introductory section and three memoranda touching solar relationships with terrestrial weather.

(5) On reviewing present knowledge of the phenomena which the committee are charged to study, they conclude that the principal terrestrial phenomena which are definitely known to be affected by intrinsic changes in the state of the sun, or by changes in the presentation of the sun toward the earth (owing to the solar rotation), are as follows:

- (a) The magnetic state of the earth and earth currents.
- (b) Aurorae.
- (c) Meteorological and climatic changes.

They conclude also that the following phenomena are not probably affected by the aforesaid solar changes, but that there is need for further series of observations in order that the matter may be thoroughly investigated.

(d) Atmospheric electricity (potential gradient and general ionization of the atmosphere).

(e) Radio-telegraphic transmission.

They conclude further that the following phenomena are sufficiently likely to be affected by such solar changes to require further investigation from this standpoint:

- (f) The amount of ozone in the upper air.
- (g) The extra-polar auroral light.
- (h) High-level atmospheric absorption.
- (i) Penetrating radiation in the atmosphere.
- (j) The light of the night sky.

(6) The committee consider that the principle variable solar phenomena which can be definitely asserted to affect terrestrial conditions are as follows:

(k) The general radiation of the sun.

(l) Local disturbance on the sun, as manifested by sunspots, faculae, and prominences.

(m) The general march of the solar cycle.

They conclude also that the following solar phenomenon probably affects terrestrial conditions, but that this has not yet been established:

(n) Solar disturbance manifested by intense local magnetic fields, but without visible markings.

They conclude further that the following solar phenomena are sufficiently likely to affect terrestrial conditions to warrant further investigation from this standpoint:

(o) The alternation of the magnetic polarity of sunspots in successive eleven-year cycles.

(p) Absorbing matter ejected from the sun, such as is indicated by photographs of the corona and of prominences.

Notes on the Relationship of Solar and Terrestrial Phenomena

551.590.2

By G. C. ABBOT

1. THE VARIATION OF SOLAR RADIATION

It seems to be well established that the sun's output of radiation is variable. The variations appear to be irregular in time and amount. They are associated, apparently, with changes in the sun's visible features. Numerous sunspots and great activity accompany a high level of the solar constant, and vice versa. But the passage of a spot or group of spots across the central solar meridian near the equator is almost invariably followed, the next day, by a minimum of the solar constant. From a comparison of Smithsonian solar work with too few determinations of Saturn's brightness, by Guthnick, it appears probable that this effect of central passage of sun-spots means that rays of diminished transparency emanate nearly radially from the sun and rotate with its rotation. Consequently, the effects pass rapidly along and reach one planet after another in order of their heliocentric longitudes. Further investigations of the brightness of the planets ought to be made to test this hypothesis.

The magnitude of solar changes seldom exceeds 5 per cent, but the total range of fairly weighty solar constant values thus far observed exceeds 10 per cent.

The investigation of solar variation is difficult and costly. The Smithsonian Institution is not assured of funds to maintain it after July, 1925. The sources of error are so insidious that long experience is almost indispensable. It is greatly to be hoped that financial means will be found to continue the two Smithsonian stations, now in operation, without a break in their records for many years.

2. INFLUENCE OF SOLAR VARIATION ON METEOROLOGY

Mr. H. H. Clayton has given by far the most study to this question. His published results in his book, *World Weather*, are notable, but his unpublished results, which I have had the opportunity to see, are even more notable. Hardly anything except the continuance of the two Smithsonian stations, I believe, would be better worth while than to give Mr. Clayton an adequate number of computers, and the assistance of one or two young men of good parts and training, so that he might devote the years remaining to him effectively to this investigation and leave trained disciples to continue it.

Referring to Figure 193, page 231, of Clayton's *World Weather*, it is to be noted that the solar changes found by Smithsonian observers in Chile were very closely paralleled, without appreciable lag in time, in the barometric pressure at Sarmiento, Argentina. They may have been a few hours' lag of the barometric curve, but certainly much less than one day. How can this correlation, in the sense high solar constant, high barometric pressure, be explained? It is not reasonable to suppose the sun's variation acts directly on the barometric pressure. It must act indirectly through the temperature. As the atmosphere absorbs a large proportion of the solar rays, from 15 per cent up, according to conditions, and as the atmosphere has but small capacity for heat, its temperature response to solar changes must be almost immediate. In this respect, we must note a distinction between the atmosphere as a whole and the layer close to the ground which is influenced to a considerable extent by slowly changing ground temperatures.

The direct influence of increase of solar radiation being to warm the atmosphere, it would tend to expand it. Thus, air would flow from regions of high atmospheric absorption to those of lower. Since barometric pressure at Sarmiento appears to increase with increasing solar constant, the inference would be that this station, which lies in an arid region about 60 miles from the Atlantic Ocean, has a clearer, less absorbing atmosphere than its surroundings. There would be great interest in tracing such conditions in other regions, with a view to establishing real relations between solar variations and terrestrial conditions.

Memorandum on the Study of Solar Radiation and Meteorology

551.5:551.590.2

By G. C. SIMPSON

As all movement in the atmosphere depends ultimately on energy received from the sun mainly in the form of solar radiation, it goes without saying that the meteorologist is vitally interested in variations, periodic and secular, in the sun's radiation.

Investigators up to the present have used two methods of attack on the problem of the relationship between the sun and the weather. In the first, sunspots have been taken to be an indication of solar activity and variations in terrestrial weather corresponding with variations in sunspots have been sought. The 11-year solar period has played the predominating part in all such investigations. The second method has made use of the data made available by the work of Abbot and his coworkers. Abbot's measurements have made it possible to follow from day to day the changes in the solar radiation received on the confines of our atmosphere, and several investigators, chief amongst them being Clayton, have attempted to correlate these with meteorological factors.

Speaking broadly, one must say that the results up to the present have been disappointing. Clear and definite relationships have not been found between sunspots and weather similar to those which have been found in the case of terrestrial magnetism. The 11-year period is certainly recognizable in some meteorological factors, but in very few cases is the amplitude of any practical importance. The investigations into the day-to-day variations of solar radiation have been little more successful, although Mr. Clayton has exhibited many interesting and suggestive curves.

It is practically impossible to work out a priori what effect an increase in solar activity would have on the weather of any given